



# SABRA, WANG & ASSOCIATES, INC.

Engineers • Planners • Analysts

## **MEMORANDUM**

**TO:** Mr. Andrew Bossi, P.E., Senior Engineer  
Montgomery County Department of Transportation  
Office of the Director  
101 Monroe Street, 10<sup>th</sup> Floor  
Rockville, MD 20850

**FROM:** Paul Silberman, P.E., PTOE  
Kyle Roberts, P.E., PTOE  
Sabra, Wang & Associates, Inc.

**DATE:** September 26, 2016

**SUBJECT: White Oak Local Area Transportation Review Intersection Improvement Cost Evaluation**

### **I. Introduction**

Implementation of the White Oak Master Plan is expected to cause intersections within and surrounding the plan boundaries to exceed the County's Local Area Transportation Review (LATR) Policy Area standards under future conditions. The purpose of this analysis is to identify potential LATR-scale costs for inclusion in a proposed per-trip fee that may be paid by new development in lieu of performing a complete LATR analysis and independently mitigating individual development's traffic impacts.

### **II. Study Area**

The White Oak Master Plan area is bounded by the County line to the east, Cherry Hill Road to the north, US 29 to the west and the Northwest Branch Trail to the south. The limits are shown in **Figure 1**. Fifty-four study intersections were selected within and just outside the Plan Area. The study intersections are shown in **Figure 2**. The study intersections fall within two of the County's LATR intersection congestion Policy Area standards. Intersections south and west of I-495 and the Northwest Branch Trail fall within the Kensington-Wheaton, Silver Spring-Takoma Park, and White Oak Policy Areas which have a Critical Lane Volume (CLV) standard of 1,600. Intersections north and west of Cherry Hill Road and US 29 fall within the Fairland Policy Area which has a CLV standard of 1,475. The Policy Area boundaries are shown in **Figure 3**. Roadways within the study area are controlled by three jurisdictions, the State, Montgomery County, and Prince George's County, and ownership is shown in **Figure 4**.



Figure 1: White Oak Master Plan Boundary

White Oak Master Plan

LATR Intersection Improvement

Planned Area

Legend

- Parcel
- Master Plan Boundary
- Water
- Park/Open Space
- Agriculture

Source: White Oak Science Gateway Master Plan, 7/2014.

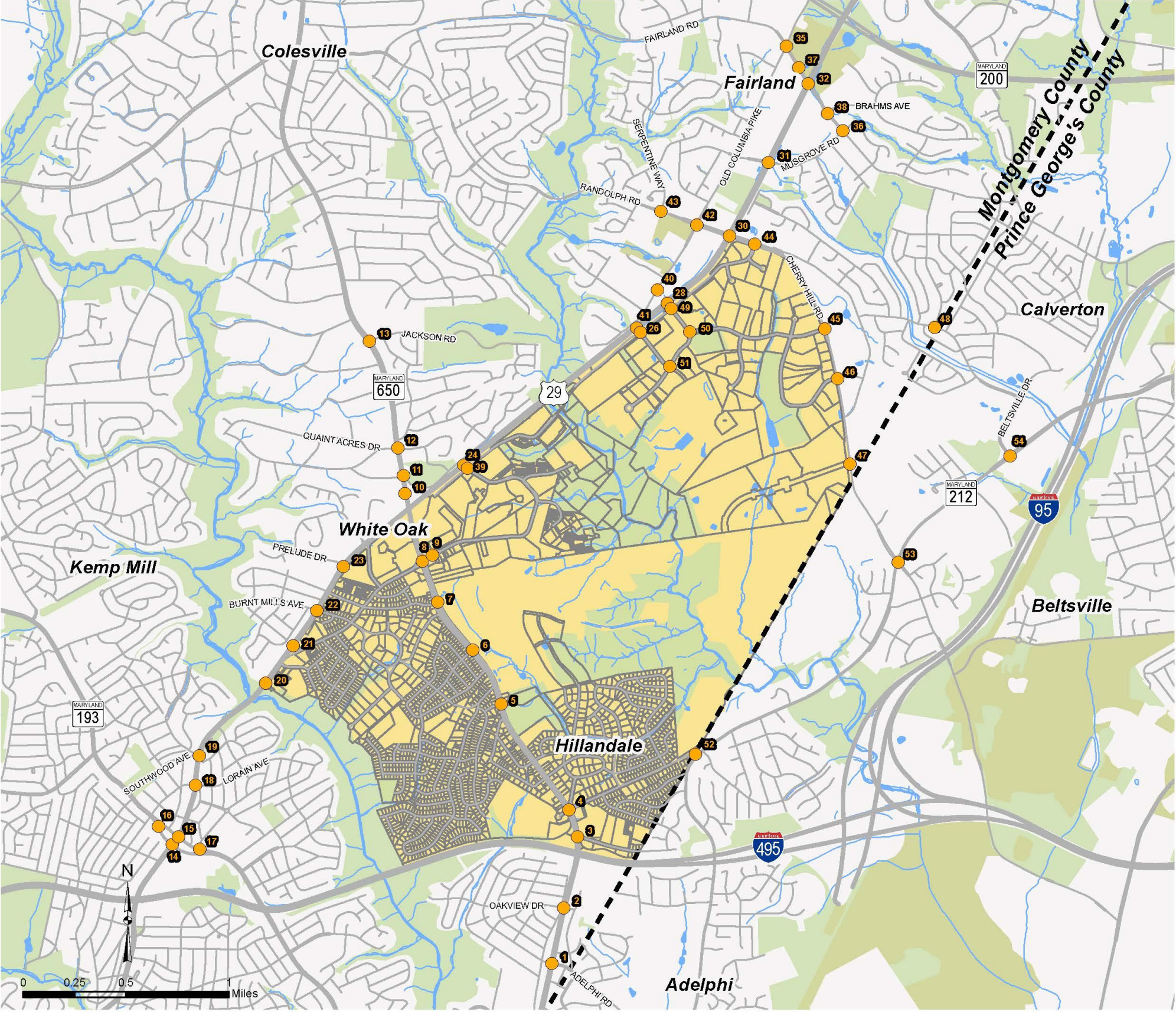




Figure 2: Study Intersections

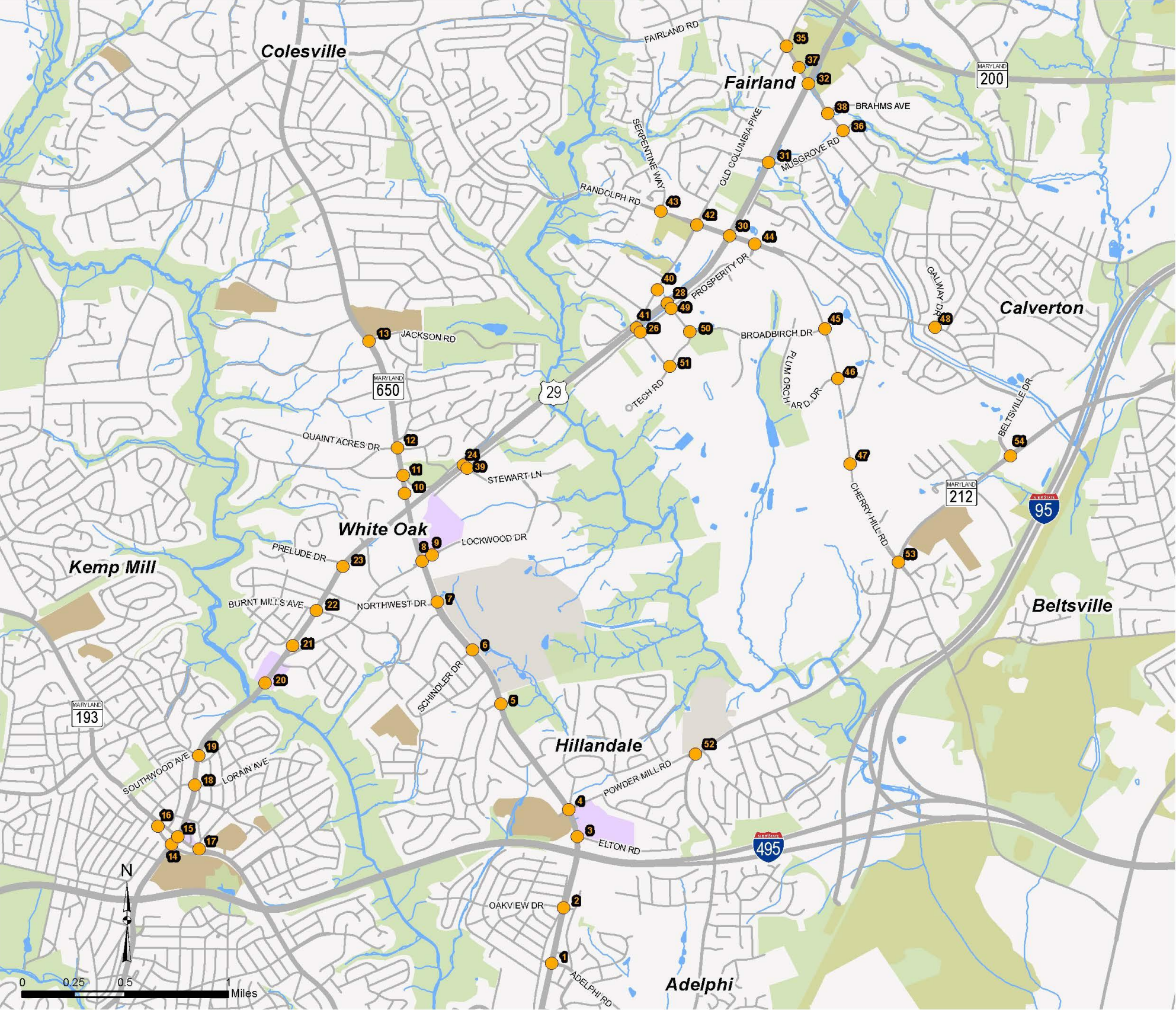
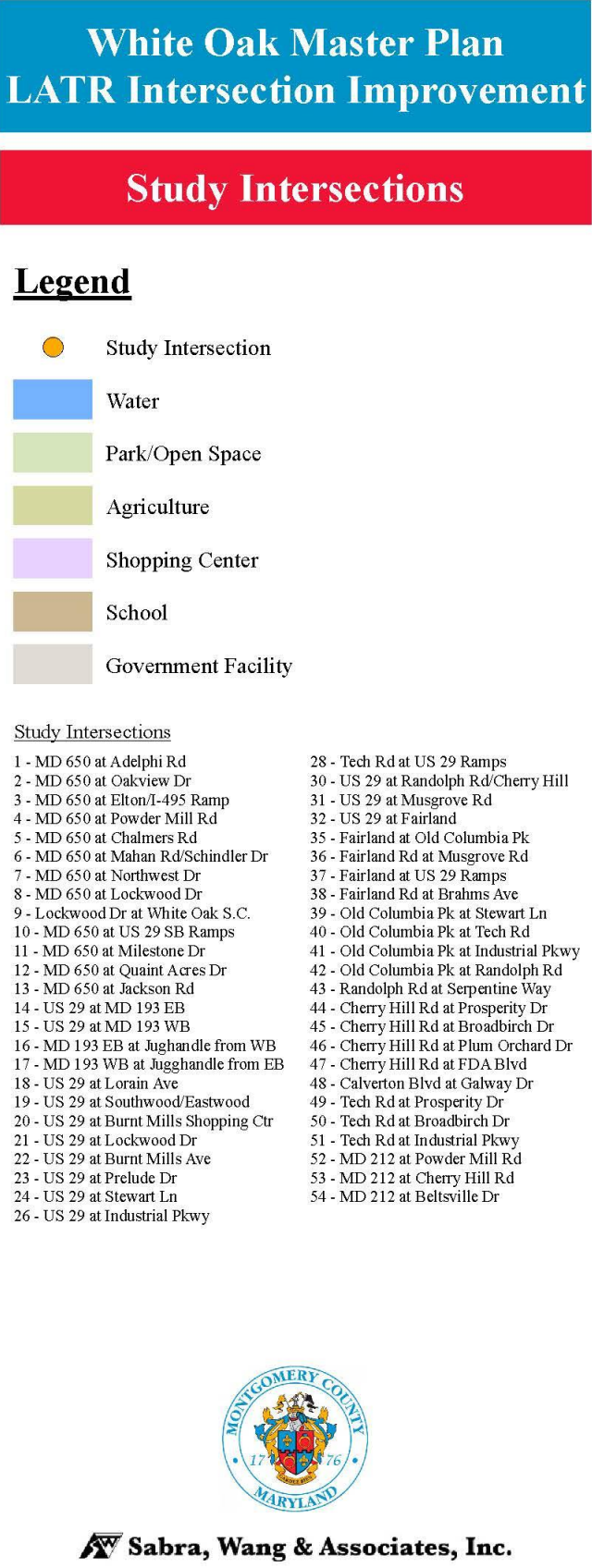




Figure 3: Policy Areas

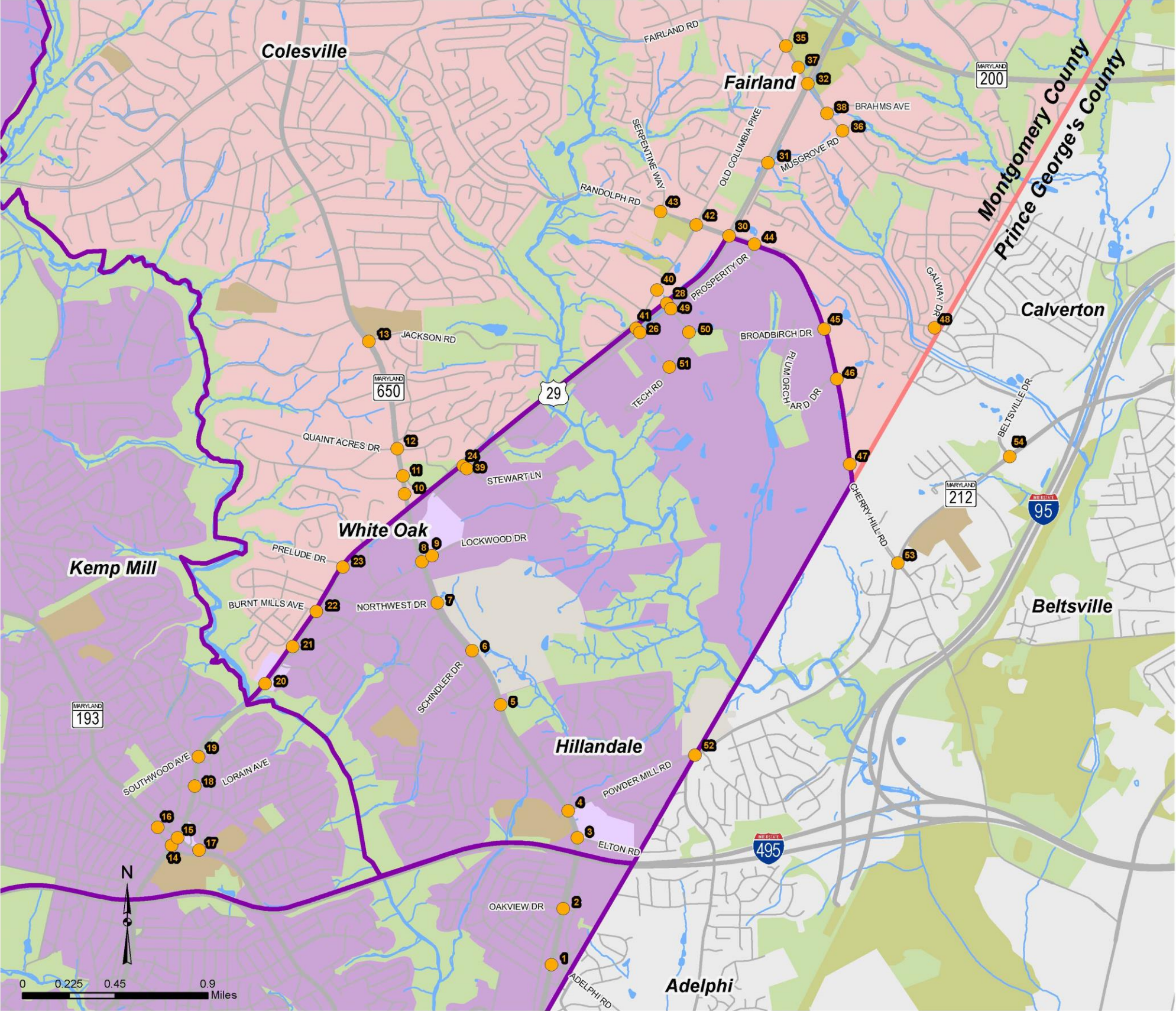
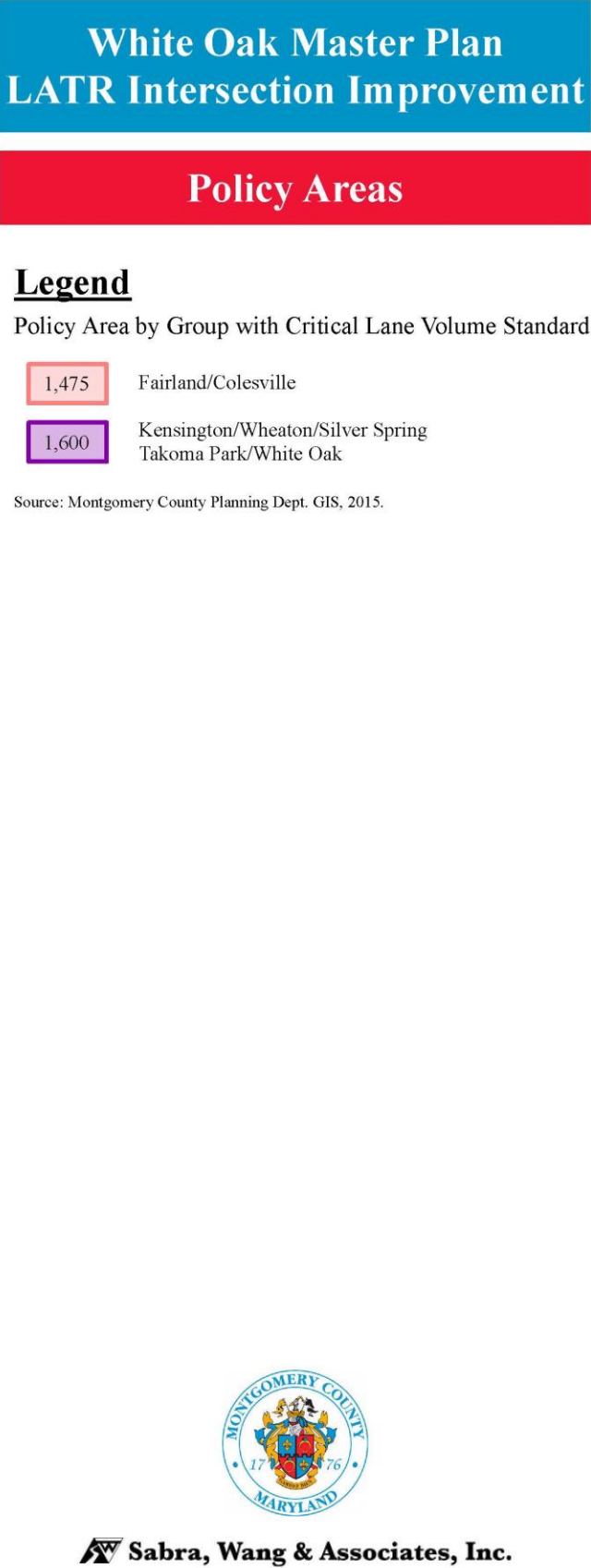




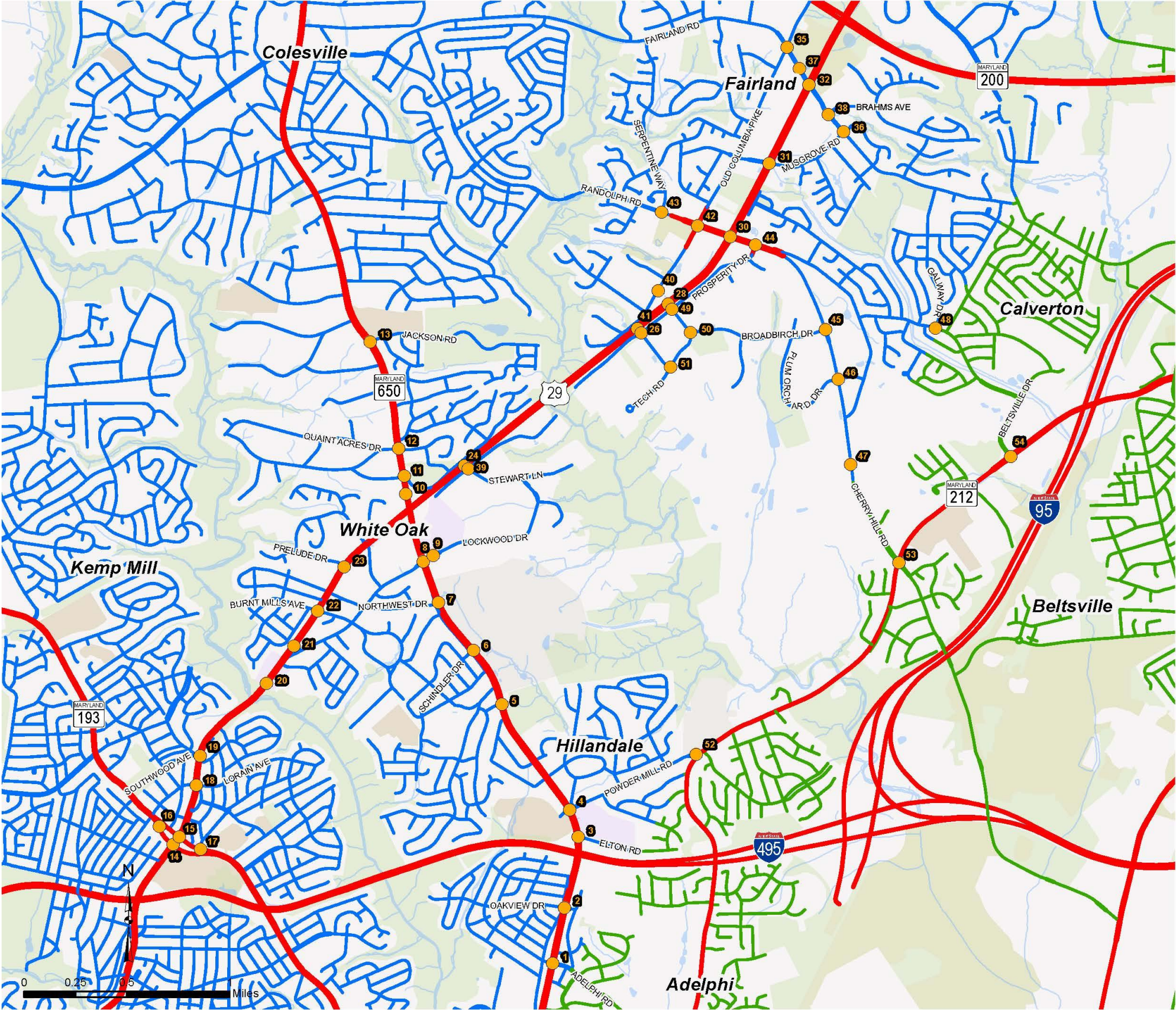
Figure 4: Roadway Ownership

White Oak Master Plan

LATR Intersection Improvement

State vs County Roads

- Legend**
- Roadway Ownership
- Maryland
  - Prince George's County
  - Montgomery County





### **III. Baseline Traffic Conditions**

Existing traffic data was collected and traffic operations analysis was performed for all study intersections.

#### **A. Traffic Volumes**

Twenty-two (22) peak period (6-10 AM & 4-7 PM) turning movement counts were collected in May of 2015. Three additional peak period turning movement counts (6-10 AM & 4-7 PM) were collected in October of 2015. The remaining locations were obtained from historical counts posted on the State Highway Administration's (SHA) I-TMS website. All historical counts used were less than 3 years old. The raw intersection traffic volumes were then input into a spreadsheet and balanced to account for sinks and sources from other intersections and driveways in order to develop a baseline set of project traffic data. Traffic counts are provided in **Appendix A**.

#### **B. Traffic Operations Analysis**

Analysis was performed at all study intersections using both the Critical Lane Volume (CLV) and Highway Capacity Manual (HCM) methodologies.

#### **Critical Lane Volume**

In the CLV analysis, lane-adjusted through and opposing volumes for both northbound-southbound and eastbound-westbound directions are determined and evaluated, and the greatest for each direction combined to develop the CLV for the intersection. Performance measures of effectiveness that were evaluated include level of service (LOS), volume-to-capacity (v/c) ratio, and critical lane volume (CLV).

Existing signal timings and phasing were obtained from the Maryland State Highway Administration and Montgomery County to verify intersection phasing and any overlaps that may affect the CLV results.

#### **Highway Capacity Methodology**

A Synchro network was developed for the baseline conditions. Synchro is a deterministic and macroscopic signal analysis computer software program that models street networks and traffic signal systems. Geometric data such as number of lanes, lane configuration, storage lengths, tapers, and distances between intersections were inputted into Synchro. Additionally, existing signal timings and phasing were obtained and coded into the Synchro traffic model along with existing traffic volumes.

Intersection capacity analyses were performed using the industry standard National Academy of Sciences Transportation Research Board's Highway Capacity Manual (HCM) methodology for all study intersections. Performance measures of effectiveness include level of service (LOS), volume-to-capacity (v/c) ratio, and average vehicle delay. Key performance measures are defined as follows:

*Level of Service (LOS)* is a qualitative measure describing operational conditions of an intersection or any other transportation facility. LOS measures the quality of traffic service, and may be determined for intersections, roadway segments, or arterial corridors on the basis of delay, congested speed, volume to capacity (v/c) ratio, or vehicle density by functional class. At intersections, LOS is a letter designation that corresponds to a certain range of roadway operating conditions. The levels of service range from 'A' to 'F', with 'A' indicating the best operating conditions and 'F' indicating the worst, or a failing, operating condition.

The *volume-to-capacity ratio* (*v/c ratio*) is the ratio of current flow rate to the capacity of the intersection. This ratio is often used to determine how sufficient capacity is on a given roadway. Generally speaking, a ratio of 1.0 indicates that the roadway is operating at capacity. A ratio of greater than 1.0 indicates that the facility is operating above capacity as the number of vehicles exceeds the roadway capacity.

*Delay (Control delay)* is the portion of delay attributed to traffic signal operation for signalized intersections. Control delay (overall delay) can be categorized into deceleration delay, stopped delay, and acceleration delay.

The results show of the CLV analysis show the following:

#### **CLV**

- Two intersections are over the policy thresholds during the PM peak hour.
  - Cherry Hill Road at Broadbirch Drive & US 29 at Stewart Lane

Existing CLV analysis results are shown in **Figure 5**. Detailed HCM and CLV reports are included in **Appendix B** and **Appendix C**, respectively.

#### **IV. Travel Forecast Model**

The US 29 BRT Study validated model was built upon to develop year 2014 and 2040 networks. The models were updated to include Master Plan network detail, the recommended Bus Rapid Transit system, and White Oak circulators. White Oak Master plan network detail in the 2040 network includes:

- BRT along US 29 and MD 650
- Old Columbia Pike Bridge
- New roadways including A-105 (Old Columbia Pike Extended through White Oak Shopping Center), A-106 (Industrial Parkway Extended), B-5 (Plum Orchard-FDA Blvd Connector), B-6 (Plum Orchard Extended), B-7 (Cherry Hill-Plum Orchard Extended)

It should be noted the analysis does not include any adjustments for Non-Auto Driver Mode Share (NADMS) factors and no specific discounts were applied for internal capture or pass-by trips.

The White Oak Master Plan and CLRP planned improvements are shown in **Figure 6** and the number of existing and proposed through lanes on each roadway segment are shown in **Figure 7**. Potential future interchanges along US 29 were not included in order to identify interim improvements at these locations. SHA's planned improvements at MD 650 and Lockwood Drive and US 29 at Stewart Lane were also not included.

Land use forecasts provided by Maryland-National Capital Park and Planning Commission and Planning Department were used to model 2040 "full build out" land use. Growth by job and dwelling units are shown in **Figure 8**. The model outputs daily vehicle trips (ADT) and traffic assignments for the White Oak area.

ADT plots of the 2014 and 2040 traffic data are shown in **Appendix D**.



Figure 5: Existing CLV Analysis

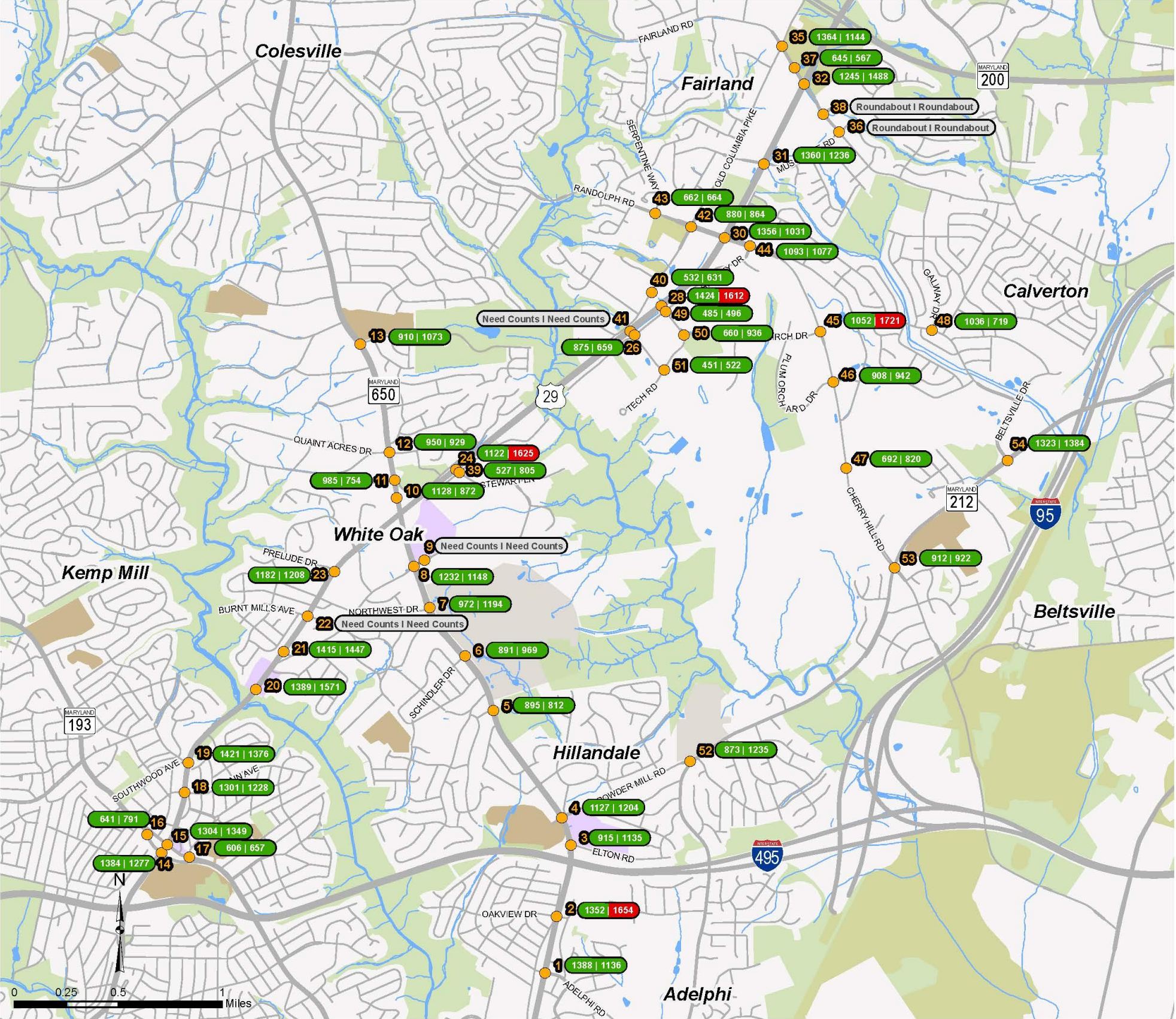
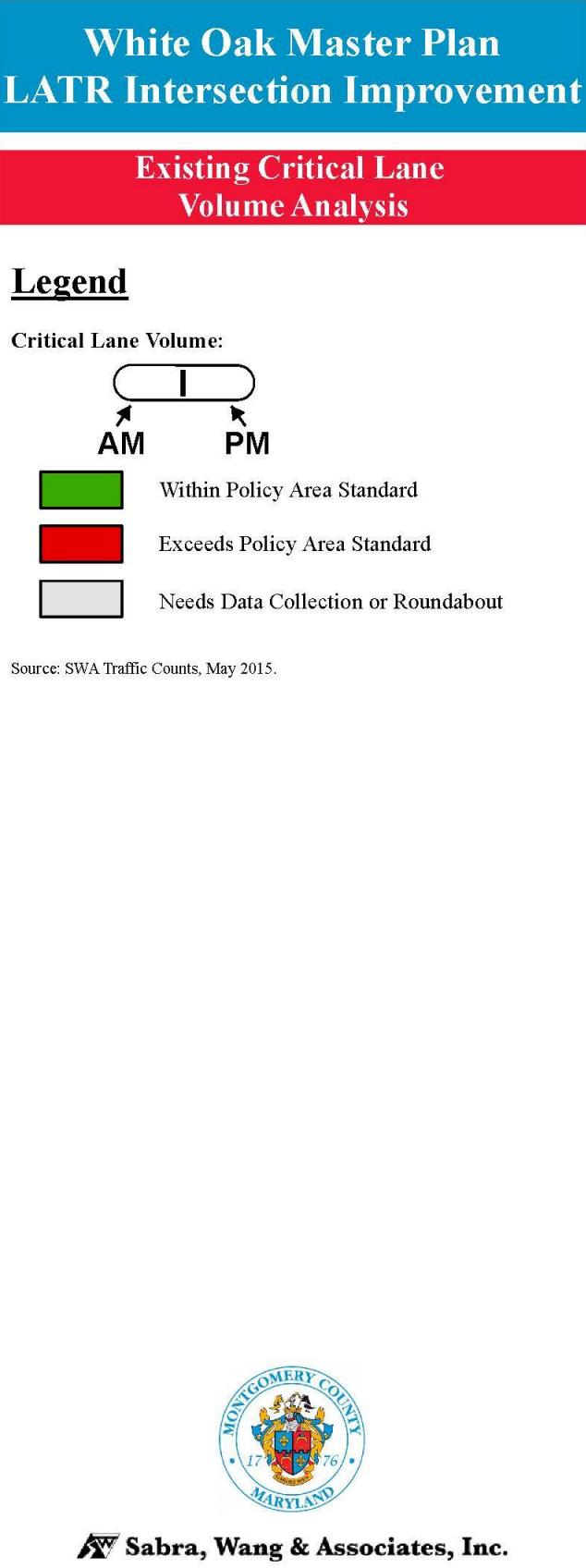




Figure 6: White Oak Master Plan & CLRP

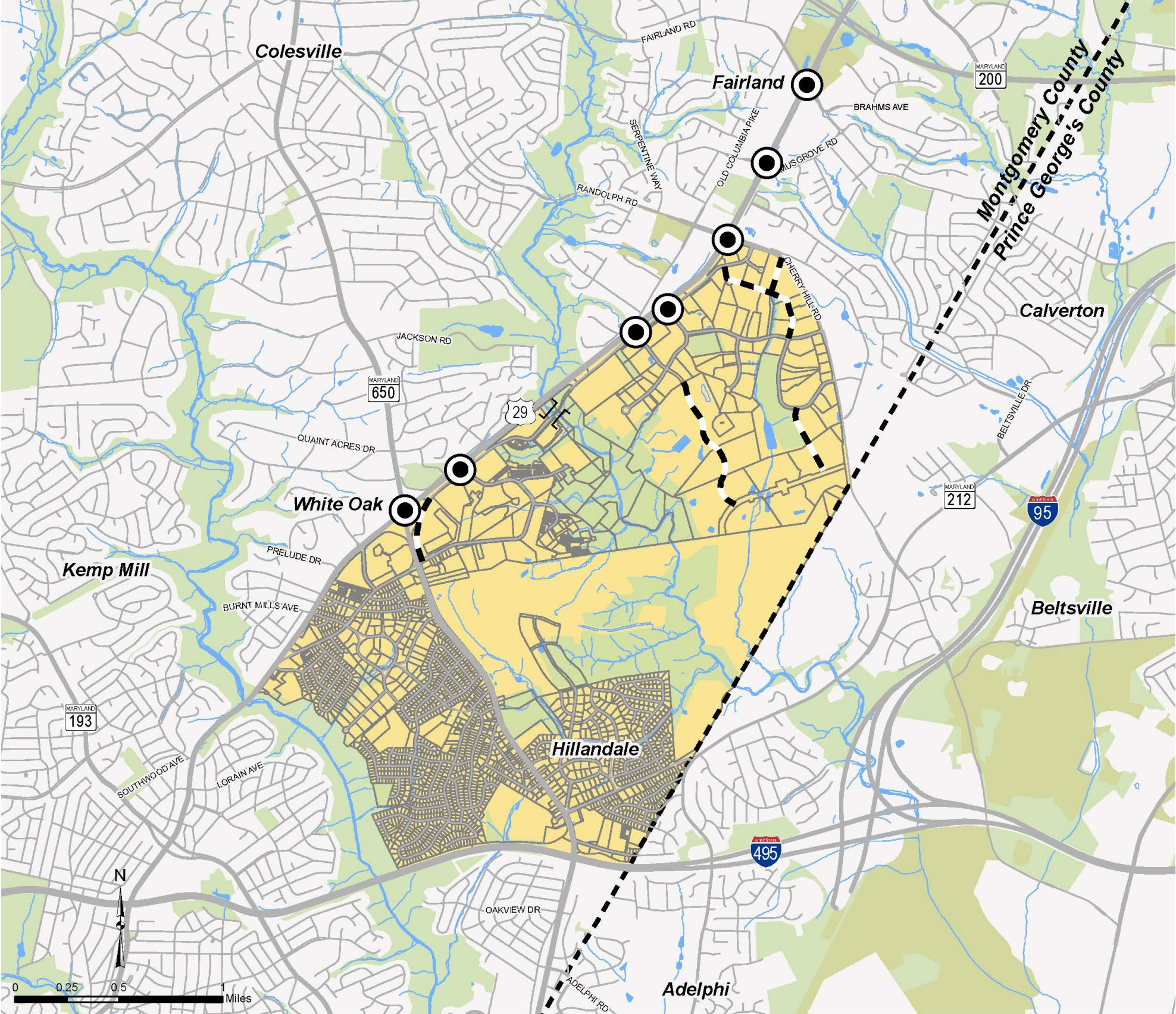
White Oak Master Plan

LATR Intersection Improvement

White Oak Master Plan & CLRP

- Legend**
- Parcel
  - Master Plan Boundary
  - Water
  - Park/Open Space
  - Agriculture
  - Planned Grade Separation/Interchange
  - Planned Road Construction
  - New Bridge

Source: White Oak Science Gateway Master Plan, 7/2014.







### Figure 7: Proposed and Existing Through Lanes

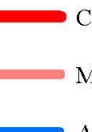










## White Oak Master Plan LATR Intersection Improvement

### Proposed & Existing Through Lanes

### Legend

-  Existing Full Interchange  
 Planned Grade Separation / Interchange

# Existing Through Lanes / # Proposed Through Lanes

- 
-  Freeway
  -  Controlled Major Highway
  -  Major Highway
  -  Arterial
  -  Business
  -  Residential Primary
  -  Planned Arterial
  -  Planned Business
  -  County Boundary
  -  Master Plan Boundary

Source: Approved and Adopted White Oak Mater Plan

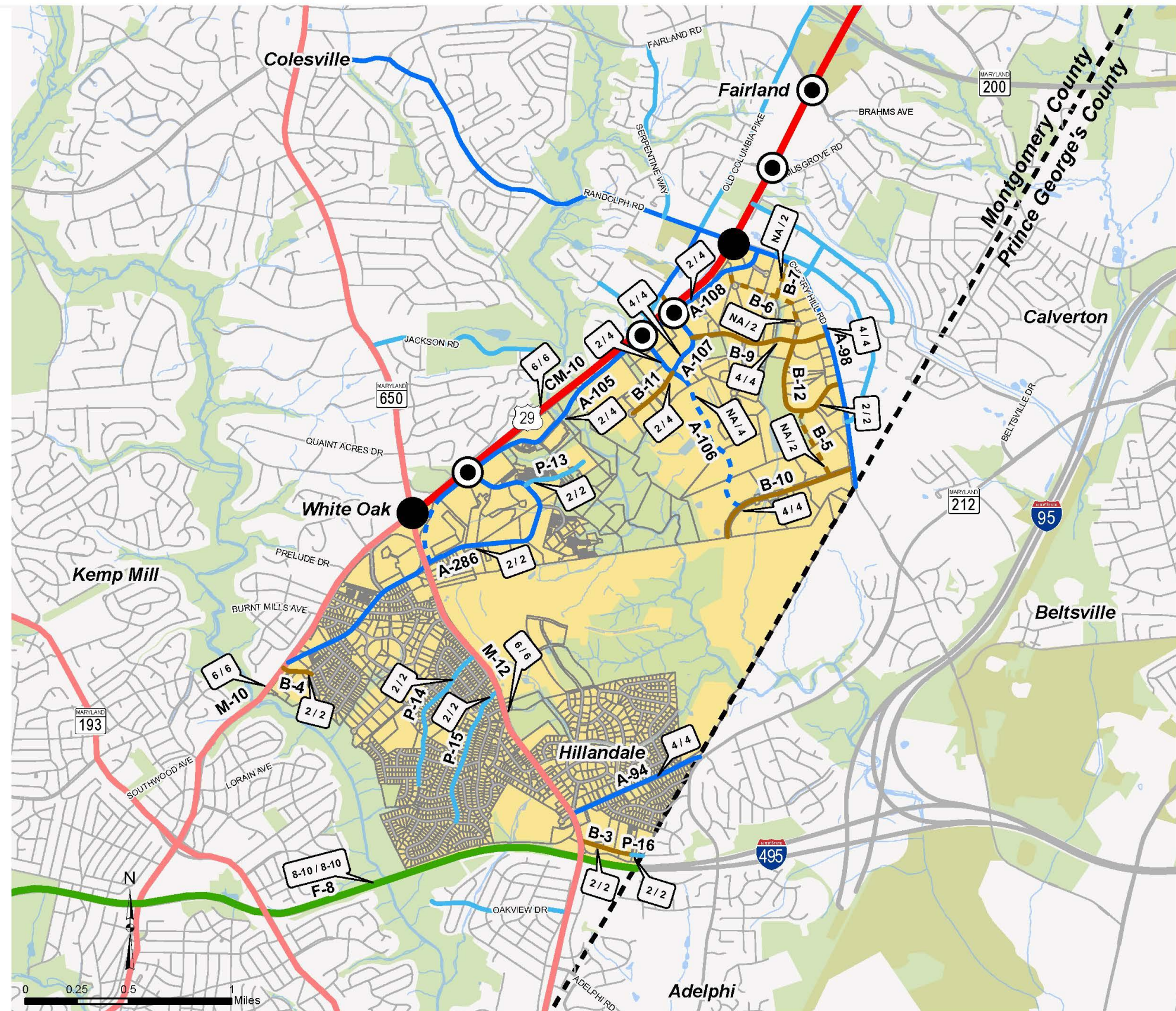
 Sabra, Wang & Associates, Inc.



Figure 8: Job and Dwelling Units Growth

White Oak Master Plan  
LATR Intersection Improvement

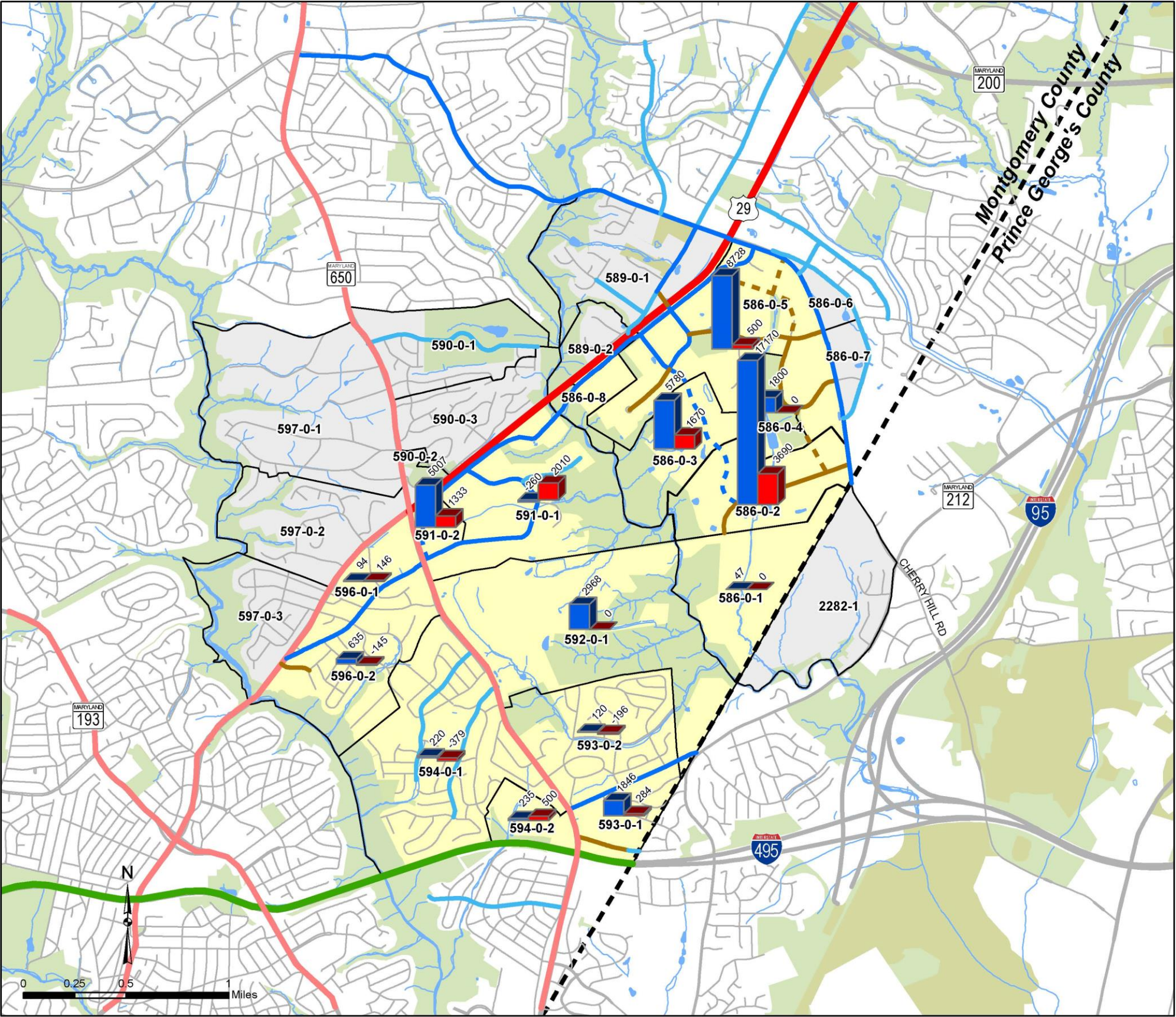
Job and Dwelling Units Growth



Source: Montgomery County Planning Department;  
Approved and Adopted White Oak Master Plan



Sabra, Wang & Associates, Inc.





## V. Future Year Traffic Conditions

### A. Post Processing

The NCHRP 255/765 post-processing methods were developed and applied to refine the model outputs for existing and projected traffic volumes and develop future year local traffic/intersection level data for the study intersections. This process developed a balanced 2040 volume set of intersection turning movement counts.

### B. Future Traffic Operations

With the 2040 horizon year intersection volumes, analysis was performed at all study intersections using both the CLV and HCM methodologies.

The results show of the CLV analysis show the following:

#### CLV

- All study intersections on US 29 except for the intersection of Randolph Road/Cherry Hill Road at the US 29 Ramps are over the policy thresholds during at least one peak hour.
- MD 650 at Oakview Drive is over the policy thresholds during both the AM and PM peak period.
- Four intersections on Old Columbia Pike are over the policy thresholds during at least one peak.
- Three intersections (5 including US 29 and Old Columbia Pike) on Tech Road are over the policy thresholds during at least one peak.
- Cherry Hill Road at Broadbirch Drive, Plum Orchard Drive at Broadbirch Drive, and FDA Boulevard at B-5 are over the policy threshold during both peak hours.

Detailed HCM and CLV reports are included in **Appendix E** and **Appendix F**, respectively.

## VI. Mitigation

Where the County's Local Area Transportation Review intersection congestion Policy Area standards are exceeded under future year conditions, physical (e.g. mainline, side street widening, or added turn lanes) or operational treatments (e.g. lane reassignment, turn restrictions, signal phasing, traffic control changes) were identified to meet the LATR standards.

The identified mitigation is shown in the intersection diagrams is shown in **Table 1** and also located in **Appendix G**. Detailed HCM and CLV reports are included in **Appendix H** and **Appendix I**, respectively. **Appendix J** compares all scenarios and contains the recommend mitigation for each intersection.

**Table 1: Recommended Mitigation by Intersection**

US 29 and MD 193 EB	Add: 1 NBT and 1 EBT
US 29 and MD 193 WB	Add: 1 NBT
US 29 and Lorain Avenue	Add: 1 NBT and 1 SBT
US 29 and Southwood Avenue	Add: 1 NBT and 1 SBT
US 29 and Burnt Mills Shopping Center	Add: 1 NBT and 1 SBT
US 29 and Lockwood Drive	Add: 1 NBT and 1 SBT
US 29 and Burnt Mills Avenue	Add: 1 NBT and 1 SBT



US 29 and Prelude Drive	Add: 1 NBT and 1 SBT
US 29 and Industrial Parkway	Add: 1 SBL   Relocation of 2 NBR from intersection
US 29 Spur and Old Columbia Pike	Relocate 2 NBR on US 29 to spur connecting to Old Columbia Pike just south of Industrial Pkwy
Cherry Hill Road and US 29 Ramps	Add: 1 EBT   Reconfigure: SBR to shared right-left
MD 650 and Powder Mill Road	Add: 1 NBR
MD 650 and Lockwood Drive	Add: 1 NBL, 1 WBT, and receiving lane on west leg
Old Columbia Pike and Fairland Road	Add: 1 SBT, 1 SB Receiving, 1 WB Receiving, and 1 EBL   Reconfigure: WBR to shared through-right
Old Columbia Pike and Tech Road	Signalization   Add: 1 WBR
Old Columbia Pike and Industrial	Signalization   Add: 1 WBR
Old Columbia Pike and Randolph Road	Reconfigure: EB lane configuration to 2 lefts and shared through-right
Tech Road and Prosperity Drive	Turn Restrictions: NBR, SBR only
Tech Road and Broadbirch Drive	Signalization   Add: 1 WBR, 1 NBR
Tech Road and Industrial Parkway	Signalization   Add: 2 EBL, 1 WBR, and 1 SBL
Cherry Hill and Broadbirch Drive	Add: 1 SBT, 1 SBR, 1 WBT, 1 EBT, 1 EBR
Cherry Hill and FDA Boulevard	Adjust: Signal Timing
Plum Orchard Drive and Broadbirch Drive	Signalization   Restripe: NB and SB Approaches to 4-lane Cross-Section
FDA Boulevard and B-5	Signalization   Add: 1 WBL, SB Channelized Right with Add Lane

## VII. Concepts and Costs

Concept plans were developed for all proposed mitigation in order to come up with cost estimates and better estimate necessary right-of-way acquisitions and environmental impacts. Concept plans for each area of mitigation are included in **Appendix K**.

Construction cost estimates were developed for each alternative using SHA's Major Quantities Estimates methodology. Major Quantities Estimates are used to estimate construction costs during the planning stage and early in the preliminary engineering stage. The idea is to estimate as accurately as possible those categories that can be estimated in the very early stages such as Grading, Paving, Structures and Shoulders items and compute the remaining categories as percentages of those categories. A total of eight categories were used for estimates. A 50% general contingency was assumed for each project along with a 10% environmental contingency and 5% utilities contingency.

Costs of mitigation included in each concept are shown in **Table 2**. The detailed cost worksheets are contained in **Appendix L** and note any special contingency assumptions. It should be noted that the cost for the US 29 corridor does not include the cost of replacing the existing bridge over the Northwest Branch.



**Table 2: Cost by Intersection**

Concept Location	Const. Cost	ROW (SF)	ROW Cost (\$)	Total Cost (\$)
US 29 at Cherry Hill Rd	\$1,460,000	15,300	\$459,000	\$1,919,000
FDA Blvd at B-5	\$1,000,000	0	\$0	\$1,000,000
Cherry Hill Rd at Plum Orchard Dr	\$2,760,000	0	\$0	\$2,760,000
Broadburch Dr at Cherry Hill Rd and Plum Orchard Dr	\$3,340,000	9,180	\$275,400	\$3,615,400
Broadburch Dr at Tech Rd	\$1,680,000	385	\$11,550	\$1,691,550
Tech Rd at Industrial Pkwy	\$3,270,000	8,171	\$245,130	\$3,515,130
US 29 at Industrial Pkwy	\$4,340,000	160	\$4,800	\$4,344,800
Tech Rd at Prosperity Dr and Old Columbia Pike	\$2,220,000	0	\$0	\$2,220,000
Old Columbia Pike at Randolph Rd	\$1,090,000	450	\$13,500	\$1,103,500
MD 650 at Lockwood Dr	\$1,320,000	0	\$0	\$1,320,000
MD 650 at Powder Mill Rd	\$1,160,000	220	\$6,600	\$1,166,600
US 29 Corridor	\$27,100,000	79,600	\$1,393,000	\$28,493,000
Old Columbia Pike at Fairland Rd	\$2,220,000	1,735	\$52,050	\$2,272,050
Old Columbia Pike at Tech Rd	\$420,000	0	\$0	\$420,000
<b>TOTAL COST:</b>	<b>\$53,380,000</b>		<b>GRAND TOTAL:</b>	<b>\$55,841,030</b>

**VIII. Next Steps**

With an estimation of potential LATR-scale costs, a proposed per-trip fee may be established by County Council that may be paid by new development in lieu of completing a complete LATR analysis and independently mitigating individual development's traffic impacts.

**Appendices:**

- Appendix A: Traffic Counts
- Appendix B: Existing CLV Worksheets
- Appendix C: Existing HCM Worksheets
- Appendix D: ADT Plots 2014 and 2040 Project Traffic Data
- Appendix E: Future CLV Worksheets
- Appendix F: Future HCM Worksheets
- Appendix G: Intersection Diagrams
- Appendix H: Future CLV Worksheets with Improvements
- Appendix I: Future HCM Worksheets with Improvements
- Appendix J: HCM & CLV Summary Table
- Appendix K: Concept Plans
- Appendix L: Construction & ROW Cost Estimate Worksheets